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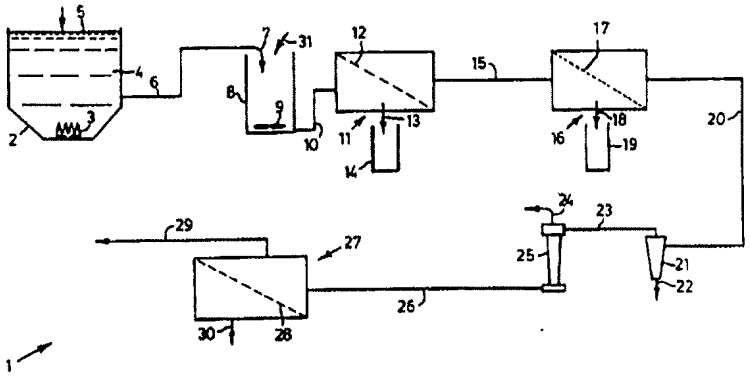
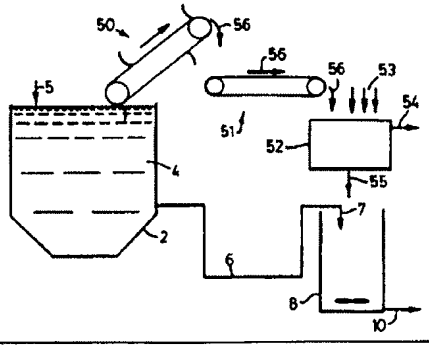
(54) Title: RECYCLING OF COATED PAPERBOARD

(57) Abstract

A process for the separation of cellulosic fibres from coated paperboard is disclosed. The coated paperboard is disclosed. The coated paperboard is comprised of at least one layer of cellulosic fibres coated on at least one side with at least one of thermoplastic polymer and metallic foil. The process comprises pulping the coated paperboard in aqueous solution in a pulper vessel (2), the pulper vessel (2) having rotating knives (3) in the bottom thereof effective for the pulping of said paperboard to form a suspension of cellulosic fibres in the aqueous solution. In a first embodiment the solution has a surface within the vessel (2). A fraction (56) comprised of thermoplastic polymer and/or metallic foil is separated from the surface of the aqueous solution in the pulper vessel (2). The process permits separation and recovery, especially for recycling, of the components of coated paperboard e.g. beverage containers. In a second embodiment the solution from the vessel (2) is continuously passed to a coarse screen (12) having a mesh size to effect separation of a substantial portion of the thermoplastic polymer and metallic foil, the solution with the cellulosic fibres passing through the screen (12). The solution with the cellulosic fibres is then subjected to cleaning by using hydrocyclone cleaners (21, 25) adapted for rejection of material heavier and lighter than cellulosic fibres respectively. Finally the cellulosic fibres are separated from the cleaned solution in a separator (27).





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TITLE
RECYCLING OF COATED PAPERBOARD

FIELD OF THE INVENTION

The present invention relates to a process for the separation of cellulosic fibres from coated paperboard, especially paperboard that is comprised of at least one layer of cellulosic fibres coated on one or both sides with at least one of thermoplastic polymer and aluminum or other foil. In particular aspects, the invention relates to a process for the recycling of coated paperboard containers such as those used in the beverage or juice industries.

BACKGROUND OF THE INVENTION

There is an increasing volume of coated paperboard in which one or both sides or faces of the paperboard have been coated with thermoplastic film or thermoplastic film and metallic, especially aluminum, foil. The resultant coated paperboard is used, in particular, in the beverage industry, for example, in the packaging of fruit juices, other liquid drinks, e.g. flavoured and sweetened aqueous drinks of various kinds, milk and a variety of other beverages. The coated paperboard used in this industry tends to be coated on both sides with an outer layer of a heat sealable thermoplastic polymer, for example, polyethylene or related polyolefin. Such coatings serve the dual purpose of providing a barrier to retain the liquid within the beverage container as well as a means by which the beverage container may be shaped and formed and retained in its formed shape e.g. using heat sealing techniques. The coated paperboard may have a layer of foil e.g. aluminum foil, usually as an intermediate layer between the thermoplastic polymer and cellulosic fibre layers.

The coated paperboard products are normally disposed of along with garbage generated by households, institutions, hotels and the like, by incineration or in landfill disposal sites. Incineration tends to result in air or other pollution being generated, whereas landfill disposal results in an accumulation of such products. In

particular, thermoplastic polymer and aluminum foil layers tend to have a long life in a disposal site.

A washing machine for washing off and separating thermoplastic polymer films from paper or cellulosic fibres or other pollutants is described in U.S. Patent No. 4,760,717 of G. Ponzielli, issued August 2, 1988. The washing machine has a container with an apertured concentric internal wall, and counter rotating intermeshing agitators therein. A process for the treatment of absorbent sanitary paper products in order to separate cellulosic fibres from other materials e.g. thermoplastic polymer layers is disclosed in published PCT Application WO 92/07995 of M.E. Conway et al, published May 14, 1992.

SUMMARY OF THE INVENTION

It has now been found that coated paperboard may be separated into a cellulosic fibre fraction and a thermoplastic polymer or thermoplastic polymer and metallic foil fraction such that the cellulosic fibres are of high quality and may be recycled into other end uses.

Accordingly, one aspect of the invention provides a process for the separation of cellulosic fibres from coated paperboard, said coated paperboard being comprised of at least one layer of cellulosic fibres coated on at least one side with at least one of thermoplastic polymer and metallic foil, comprising:

(a) pulping the coated paperboard in aqueous solution in a pulper vessel, said pulper vessel having rotating knives located in the bottom thereof effective for the pulping of said paperboard to form a suspension of cellulosic fibres in the aqueous solution and said vessel being such that the solution has a surface within the vessel;

(b) separating a fraction comprised of at least one of thermoplastic polymer and metallic foil from the surface of said aqueous solution in the pulper vessel.

In preferred embodiments of the invention, the aqueous solution has a pH that is substantially neutral to

alkaline, especially substantially neutral. In other embodiments, the pH is at least 9.5.

In further embodiments of the invention, the fraction separated from the surface of the aqueous solution is washed to separate cellulosic fibres from said fraction, the cellulosic fibres being optionally combined with the aqueous solution from the pulper.

In other embodiments, solution from the vessel of (a) is passed to a coarse screen having a mesh size to effect separation of a substantial portion of the thermoplastic polymer and metallic foil from the cellulosic fibres, solution with cellulosic fibres passing through the screen; and then subjected to at least two hydrocyclone cleaners, the first of said hydrocyclone cleaners being adapted for rejection of material heavier than cellulosic fibres and the second of the hydrocyclone cleaners being adapted for the rejection of material lighter than cellulosic fibres.

Preferably, the solution passing through the screen is subjected to a second screen, said second screen having a finer mesh size than the first screen.

In another embodiment of the present invention, the first screen has a mesh size in the range of 0.025-0.055 inches, especially 0.035-0.045 inches. In a further embodiment, the second screen has a mesh size of 0.006-0.012 inches.

In embodiments of the process of the invention, the coated paperboard is coated on both sides of the layer of cellulosic fibres.

In other embodiments, the solution of (a) contains potassium hydroxide and/or sodium hydroxide.

In further embodiments, the metallic foil is aluminum foil.

In preferred embodiments of the processes of the invention, the process includes a step of de-inking the cellulosic fibres in the aqueous solution.

A further aspect of the invention provides a process for the separation of cellulosic fibres from coated paperboard, said coated paperboard being comprised of at least one layer of cellulosic fibres coated on at least one side with at least one of thermoplastic polymer and metallic foil, comprising:

(a) pulping the coated paperboard in aqueous solution, in a pulper vessel, at substantially neutral or alkaline pH, optionally at a pH of at least 9.5, said pulper vessel having rotating knives located in the bottom thereof effective for pulping of said paperboard to form a suspension of cellulosic fibres in the aqueous solution;

(b) continuously passing solution from the vessel of (a) to a coarse screen having a mesh size to effect separation of a substantial portion of the thermoplastic polymer and foil from cellulosic fibres, solution with cellulosic fibres passing through the screen;

(c) subjecting the solution passing through the screen to at least two hydrocyclone cleaners, the first of said hydrocyclone cleaners being adapted for rejection of material heavier than cellulosic fibres and the second of the hydrocyclone cleaners being adapted for the rejection of material lighter than cellulosic fibres; and

(d) separating cellulosic fibres from the solution of (c).

DETAILED DESCRIPTION OF THE INVENTION

The present invention is illustrated by the embodiments shown in the drawings, in which:

Fig. 1 is a schematic representation of the process of the invention;

Fig. 2 is a schematic representation of a preferred embodiment of the process of the invention in which a fraction is separated from the surface of a solution; and

Fig. 3A and 3B are schematic representations of scoops for the bucket conveyer.

The present invention is generally described herein with reference to the metallic foil being aluminum foil. Other metallic foils may be used.

Fig. 1 shows apparatus, in schematic form, for the treatment of coated paperboard, such apparatus being generally indicated by 1. In the embodiment shown, pulper vessel 2 has pulper knives 3 located in the bottom of that vessel. In embodiments, vessel 8 is a vertical vessel. It is preferred that vessel 8 be of a type that may be completely emptied without retention of fluid or fibres in the bottom thereof. Pulper knives 3 are of a type that are effective in the pulping of coated paperboard fed into solution 4 via conveyer 5, and may be of a type known as sharks teeth. It is to be understood that the coated paperboard may be at least partially shredded prior to being fed to vessel 8, but shredding in vessel 8 is preferred.

Transfer line 6 is used to pass solution 4 from pulper vessel 2 to inlet 7 into vessel 8. Vessel 8 is a stirred vessel, being stirred by stirrer 9, and has water inlet 31. Transfer line 10 passes solution from vessel 8 to first screen vessel 11. First screen vessel 11 has a coarse screen 12. On the upstream side of coarse screen 12 is discharge outlet 13 for the discharge of large particles i.e. particles not passing through coarse screen 12, into bin 14. On the downstream side of first screen vessel 11 is transfer line 15 for the discharge of solution passing through coarse screen 12. Transfer line 15 passes solution into the upstream side of second screen vessel 16. Second screen vessel 16 has a discharge outlet on the upstream side of fine screen 17, indicated by 18, into bin 19, for particles that will not pass through fine screen 17. The downstream side of fine screen 17 is connected to transfer line 20.

Transfer line 20 is connected to a hydrocyclone cleaner that is referred to herein as a Posiflow cleaner, 21. The discharge of heavy particles from Posiflow cleaner

21 occurs through discharge outlet 22. Solution with lighter particles is discharged from Posiflow cleaner 21 through transfer line 23 to the inlet of a hydrocyclone cleaner that is referred to herein as a Uniflow cleaner, 25. Light particles are discharged from Uniflow cleaner 25 through discharge outlet 24. The bulk of the material from Uniflow cleaner 25 is discharged through transfer line 26 into separator 27. Separator 27 has a screen 28 to effect separation of cellulosic fibres through upstream outlet 29 and for the discharge of liquid passing through screen 28 out of discharge 30.

In operation of the embodiment of Fig. 1, coated paperboard especially in the form of beverage boxes, is fed through conveyer 5 into pulper vessel 2. In pulper vessel 2, the coated paperboard is pulped using pulper knives 3 to form a solution of relatively uniform consistency. This part of the process is normally operated as a batch process, and results in the coated paperboard being converted into smaller pieces, and especially to expose the cellulosic fibres to the aqueous solution. It is preferred that the pulped solution contain 3-12% pulp, sometimes referred to herein as a consistency of 3-12%, more preferably 3-10% pulp and especially 5-6% pulp. The actual apparatus used will have an effect on the preferred consistency for the process. In addition, the pulping is preferably operated such that the amount of film and aluminum foil fed to the hydrocylones, as described herein, is not more than 10% of the amount of cellulosic fibres, especially not more than 7% by weight. Preferred amounts are 4-6% by weight.

The composition of the pulp will depend on the nature of the coated paperboard fed to the process. For instance, if the coated paperboard is juice boxes, the pulp may contain about 55% cellulosic fibre, about 40% plastic and 5% aluminum. Other coated paperboard will have different amounts of cellulosic fibre, plastic and aluminum. Some coated paperboard will not contain aluminum

or other metallic foil. The ratio of cellulosic fibre to plastic may vary over a wide range. Such wide variations in the ratio of cellulosic fibre : plastic : aluminum foil are acceptable, and the ratio in an operating process is likely to vary considerably with time, depending on the origin of the feedstock.

The pulped coated paperboard is discharged from pulper vessel 2 through transfer line 6; the remainder of the process is normally a continuous process. This process begins with discharge of the pulped solution through inlet 7 into vessel 8. The consistency, especially the viscosity of the solution in vessel 8, is monitored and water is added through water inlet 31 in order to obtain the solution within vessel 8 with a consistency, especially a solution viscosity, within a predetermined range, determined by the requirements of subsequent steps in the process. Solution is continuously passed through transfer line 10 into first screen vessel 11, in which large particles of thermoplastic polymer, usually essentially in the form of thermoplastic polymer film, and pieces of metallic foil, are separated as these are not passed through the coarse screen 12. The mesh size of coarse screen 12 is selected to effect such a separation. Cellulosic fibres and solution pass through coarse screen 12 and are transferred using transfer line 15 into second screen vessel 16. Second screen vessel 16 has a screen of a smaller mesh size than that of first screen vessel 11. Further separation of thermoplastic polymer and metallic foil particles is effected in second screen vessel 16. Second screen vessel 16 effects a separation of pieces of thermoplastic polymer film and metallic foil that were small enough to pass through coarse screen 12 but not through fine screen 17. These particles of thermoplastic polymer film and metallic foil are discharged from the upstream side of fine screen 17 in second screen vessel 16.

Cellulosic fibre and solution pass through fine screen 17 and are transferred through transfer line 20 into

Posiflow cleaner 21. Posiflow cleaner 21 effects a separation of dense particles from the solution, which are discharged through discharge outlet 22. The bulk of the solution, containing the cellulosic fibres, is passed through transfer line 23 to the inlet of Uniflow cleaner 25. Uniflow cleaner 25 effects a separation of low density particles from the solution, through discharge outlet 24. Again, the bulk of the solution passes through transfer line 26 into separator 27. Separator 27 effects a separation of solution from cellulosic fibres. In a particular embodiment, separator 27 is known as a dynamic washer, which effects both separation of the cellulosic fibres and the washing of those fibres, which are discharged through upstream outlet 29.

In a preferred embodiment of the invention, illustrated in Fig. 2, pulper vessel 2 has a bucket conveyer 50 at the surface of solution 4. Bucket conveyer 50 removes thermoplastic polymer and/or metallic foil components from the surface of aqueous solution 4 and deposits them, as indicated by arrow 56, onto transfer conveyer 51. It is understood that the scoops of the bucket conveyer would normally be fabricated to retain thermoplastic polymer or metallic foil but pass cellulosic fibres and solution.

In particular, the scoops of bucket conveyer 50 may be in the form of a bucket with orifices or mesh in the bottom thereof, with the size of the orifices or mesh being large e.g. at least 2.5 cm in size and especially in the range of 2.5-6 cm in size. Alternatively, the scoops of the bucket conveyer may be in the form of tynes. Although a single tyne could be used in some circumstances, at least two tynes should be used and especially 3-6 tynes. Such tynes may be spaced apart by at least 2.5 cm and especially 2.5-6 cm. Other shapes of scoops may be used. Tynes are preferred. It is understood that the pieces of thermoplastic polymer and/or metallic foil that are removed with the bucket conveyer may be relatively large e.g. have

dimension of several centimeters in one or more directions, and it is intended that the bucket conveyer remove at least a substantial proportion of such pieces from pulper vessel 2.

Transfer conveyer 51 in turn deposits the thermoplastic polymer and/or metallic foil components into washing vessel 52. In washing vessel 52, the separated component is washed using spray nozzles 53, before being removed from washing vessel 52 through line 54. Cellulosic fractions or other fractions of small size washed from the thermoplastic polymer and/or metallic foil component passes from washing vessel 52 through line 55 into vessel 8, and may be processed as described above. Thermoplastic polymer and/or metallic foil component is passed from washing vessel 52 for further processing e.g. for separation of entrained cellulosic fraction or of thermoplastic polymer from metallic foil components and/or baling or the like.

Fig. 3A shows a section of a bucket conveyer, having conveyer belt 60 with bucket 61 thereon. Bucket 61 is attached to conveyer belt 60 by bolts 62. Scoop 61 is in the form of a bucket, having a base 63. Base 63 of bucket 61 has a plurality of orifices 64. As discussed herein, the orifices should have a diameter of at least about 2.5 cm and especially about 2.5-6 cm. While Fig. 3A shows a bucket with orifices in the bottom thereof, it is understood that the bucket could have a mesh in the bottom thereof.

Fig. 3B shows conveyer belt 60 having base plate 65 attached thereto by bolts 66. Base 65 has tynes 67 extending therefrom. In the embodiment shown in Fig. 3B, four tynes 67 are shown, although the number of tynes could be two or more, as discussed herein. Tynes 67 should be spaced apart by at least about 2.5 cm and especially about 2.5-6 cm, as discussed herein.

The invention has been particularly described herein with reference to the use of a bucket conveyer to separate thermoplastic polymer and/or metallic foil from

the surface of the aqueous solution. While this is the preferred method, other skimming devices, weirs or baffles could be used.

The paperboard is coated on a least one side with at least one of thermoplastic polymer and metallic foil. The thickness of the paperboard will vary depending on the particular end use of the coated paperboard. However, in the beverage and juice packaging industries, typical thicknesses are in the range of about 175 to about 450 g/m. The thermoplastic polymer coating will normally be a heat sealable coating, at least the outer coating will normally be heat sealable for ease of fabrication of the beverage or juice container. Such coatings may be a polyolefin e.g. polyethylene, polypropylene, ethylene copolymers e.g. ethylene/vinyl acetate copolymers and the like, and would comply with health and other regulations for packaging of foodstuffs. The metallic foil is normally used as a barrier layer, and interposed between layers of the thermoplastic polymer, or between thermoplastic polymer and a layer for the bonding of the foil to the cellulosic layer i.e. the paperboard. The metallic foil will usually be aluminum foil.

The process may be operated with the aqueous solution in vessel 2 at substantially neutral pH or at alkaline pH. The pH of solutions in subsequent steps in the process will generally tend towards a neutral pH, due to washing procedures or addition of water. Substantially neutral pH is intended to mean the pH obtained by use of municipal water, or other similar water, which will likely to be at a slightly acidic pH in the pulper due to residual amounts of liquid in the coated paperboard especially where the coated paperboard is in the form of juice boxes which can contain residual amounts of e.g. orange juice. Substantially neutral pH is preferred, especially for economic and environmental reasons. Alkaline pH's may be used, including a pH of at least 9.5, and preferably at least 10. This solution is preferably formed from an

alkali metallic hydroxide, especially sodium and/or potassium hydroxides. Sodium hydroxide is preferred.

In its overall context, the present invention will permit a recycling system that would involve the collection of coated paperboard, especially in the form of beverage boxes, after use, in thermoplastic polymer bags or other suitable collection containers, including a polyethylene bag, from households, institutions, hotels and the like. The coated paperboard would then be transported to a processing facility for treatment according to the process of the present invention.

Cellulosic material obtained from the process of the invention is relatively un-degraded and un-refined material, compared to cellulosic material that has been subjected to processes for the manufacture of paper, tissue or towelling. In addition, the cellulosic material may be cleaner, i.e. whiter, than cellulosic material obtainable from many other sources. It has potential for use in a wide variety of end uses, including recycling back into beverage box manufacturing processes. Many of the solutions used in the process may be treated for recovery of components, reused in the process, or in other processes. For example, solution may be recycled from separator 27 back into pulper vessel 2.

The hydrocyclone cleaners referred to above have been described with respect to Fig. 1 as being Posiflow cleaners 21 and Uniflow cleaner 25, both of which are obtainable from the Beloit Jones Division of Beloit Corporation, Dalton, Mass., U.S.A.. The former type of hydrocyclone cleaner effects removal of heavy particulate matter and the latter effects removal of lighter particulate matter. It is understood that a plurality of hydrocyclone cleaners may be used, both of the Posiflow cleaner type and of the Uniflow cleaner type. Each type of hydrocyclone cleaner may be used in parallel with similar hydrocyclone cleaners and/or in series with similar

hydrocyclone cleaners in order to more effectively separate heavy and lightweight matter.

It is understood that vessels e.g. holding tanks, may be inserted into any stage of the process in order to control the rate of flow of solution through the process. This is likely to be particularly important if any stage of the process is operated in a batch mode.

The coated paperboard fed to the aqueous solution may be in a comminuted form. If so, it is preferred that the coated paperboard not be in a fine particle form as such particles would tend to pass through the screens and not be removed, causing process complications in subsequent steps in the process. It is preferred, if the coated paperboard is comminuted prior to feeding to the solution, that the particles be relatively large to facilitate removal either on the first screen or more preferably using the bucket conveyer as described above. However, in preferred embodiments of the invention the coated paperboard is fed to the aqueous solution without being comminuted, with the first vessel then being in the form of a pulper equipped with rotating knives to effect the breakdown of the coated paperboard into smaller pieces. Such a use of a pulper has been found to be a useful way of obtaining the coated paperboard in a suitable size to effect the separations described herein. If the coated paperboard is comminuted prior to feeding to the aqueous solution, then the aqueous solution in the first vessel is admixed vigorously but not necessarily pulped, so that the cellulosic fibres become dispersed within the solution. However the admixing should not be so vigorous as to cause thermoplastic polymer and metallic foil pieces to be pulled down from the surface of the vessel into the bulk of the solution, thereby making separation using a bucket conveyer more difficult.

It is possible to increase the amount of coated paperboard in the aqueous solution to an extent such that on pulping or agitation, the particles of thermoplastic

polymer and metallic foil become immersed within the solution in a relatively uniform manner. If the amount of coated paperboard in the aqueous solution is reduced, the thermoplastic polymer and metallic foil tends to accumulate at the top of the aqueous solution, thereby facilitating removal. It is preferred that the process be operated such that there is some natural separation of cellulosic fibres from the less dense thermoplastic polymer and metallic foil in the aqueous solution. The use of the lower concentrations will also facilitate subsequent processing of the materials.

In preferred embodiments of the present invention, the solution is subjected to one or more steps to remove ink. This may be accomplished using a pressurized de-inking module, which is obtainable from the Beloit Jones Division of Beloit Corporation, Dalton, Mass., U.S.A. Such a pressurized de-inking module would normally be inserted in the process subsequent to the screen used to separate fine particulate matter. One or more pressurized de-inking modules may be used. Such a use of a pressurized de-inking module will result in the production of cellulosic fibres of improved colour.

In embodiments of the invention, the first screen in the process has a mesh size in the range of 0.025-0.055 inches, especially in the range of 0.035-0.045 inches. It is preferred that any second screen in the process has a mesh size in the range of 0.006-0.012 inches.

Although the first screen may be used for separation of thermoplastic polymer and metallic foil of relatively large size, it is preferred that a bucket conveyer be used to remove such material, as described above. Use of the first screen for such removal may lead to process difficulties in a continuous operation of the process.

The vessel shown as vessel 8 in Fig. 1 may be a vessel of a type known as a trommel or used in conjunction with a trommel. Such vessels are used to accomplish both

separation and washing of the material passing through the vessel.

It is to be understood that immediately prior to separator 27, shown in Fig. 1, the cellulosic fibres may be subjected to steps for brightening, washing and/or treatment with disinfectant in order to improve the quality of the product being obtained and/or to meet various governmental regulations. If the metallic foil component is aluminium, which is commonly used in packaging, then the aluminium may be separated from thermoplastic polymer using, for example, alkaline solutions. Alternatively, the polymer could be burnt off the foil. The thermoplastic polymer, which is normally a polyolefin, may be used in a variety of end uses.

The present invention is illustrated by the following examples:

EXAMPLE I

Beverage boxes were received from institutions. These boxes contained straws and unconsumed juices. The boxes were fed to a pulper and pulped in aqueous solution for about 30 minutes. The pulping was carried out in a manner such that pieces of thermoplastic polymer and metallic foil floated to the top of the solution. These pieces were removed using a bucket conveyer, washed in a trommel to remove free cellulosic fibres and then baled. The bales contained approximately 93% thermoplastic polymer, 5% aluminum foil and 2% cellulosic fibres. In contrast, juice boxes typically contain about 20% thermoplastic polymer, 5% aluminum foil and 75% cellulosic fibres.

The solution from the pulper was combined with the cellulosic fibres from the trommel, and then subjected to a coarse screen with a mesh size of 0.035 inches and then a fine screen with a mesh size of 0.006 inches.

Solution passing through the fine screen was subjected to a hydrocyclone to remove heavy particulate, and then a pressurized de-inking module to remove ink and

other particulate. The solution was then subjected to hydrocyclones to remove heavy and then lightweight particulate matter, and to brightening and washing steps.

The cellulosic fibre separated from the process was white and of good quality, suitable for recycling as tissue-grade or fine paper-grade fibre.

EXAMPLE II

Approximately 63,500 pounds of juice boxes and milk cartons, being in the form of polyethylene-coated cardboard or polyethylene and aluminum foil-coated cardboard, were fed to a process of the invention. The juice boxes were fed in 28 separate loads with an average weight of approximately 1300 pounds, and for these boxes a pulping time of 32 minutes was used. The milk cartons were fed in 19 separate loads at an average weight of 1260 pounds per load with an average pulping time of 49 minutes. One further load of mixed juice boxes and milk cartons weighing approximately 1300 pounds was also fed to the process, with a pulp time of 30 minutes.

In all batches processed, the pulp consistency was approximately 5-5.5% by weight of the aqueous solution. The process was operated at substantially neutral pH i.e. municipal water was used without addition of alkali. The process was also operated at ambient temperature.

The boxes were pulped and processed using a process of the type shown in Fig. 1. The knives used in the pulper were of a type referred to herein as shark knives.

Solution passing from the pulper was subjected to a course screen with a mesh size of 0.035 inches and then to a fine screen with a mesh size of 0.010 inches.

Solution passing from the fine screen was subjected to a pressurized de-inking module for removal of fine particulate matter, including fine plastic material, aluminum foil and ink. The solution was then subjected to hydrocyclones to remove heavy and then lightweight

particulate matter, and then to brightening and washing steps.

The cellulosic fibre separated from the process was found, on visual inspection, to be white and of good quality. Visual inspection also showed that plastic and aluminum foil had been separated effectively from the cellulosic fibre.

This example shows that the process is capable of being operated on substantial quantities of juice boxes and milk cartons.

CLAIMS:

1. A process for the separation of cellulosic fibres from coated paperboard, said coated paperboard being comprised of at least one layer of cellulosic fibres coated on at least one side with at least one of thermoplastic polymer and metallic foil, comprising:

(a) pulping the coated paperboard in aqueous solution in a pulper vessel, said pulper vessel having rotating knives located in the bottom thereof effective for the pulping of said paperboard to form a suspension of cellulosic fibres in the aqueous solution and said vessel being such that the solution has a surface within the vessel;

(b) separating a fraction comprised of at least one of thermoplastic polymer and metallic foil from the surface of said aqueous solution in the pulper vessel.

2. The process of Claim 1 in which the aqueous solution has a pH that is substantially neutral to alkaline.

3. The process of Claim 1 or Claim 2 in which the fraction separated from the surface of the aqueous solution is washed to separate cellulosic fibres from said fraction.

4. The process of any one of Claims 1-3 in which solution from the vessel of (a) is passed to a coarse screen having a mesh size to effect separation of a substantial portion of the thermoplastic polymer and metallic foil from the cellulosic fibres, solution with cellulosic fibres passing through the screen; and then subjected to at least two hydrocyclone cleaners, the first of said hydrocyclone cleaners being adapted for rejection of material heavier than cellulosic fibres and the second of the hydrocyclone cleaner being adapted for the rejection of material lighter than cellulosic fibres.

5. The process of any one of Claims 1-4 in which the solution passing from the screen is subjected to

a second screen, said second screen having a finer mesh size than the first screen.

6. The process of any one of Claims 1-5 in which there is a screen and said screen has a mesh size in the range of 0.025-0.055 inches.

7. The process of Claim 6 in which the mesh size is 0.035-0.045 inches.

8. The process of any one of Claims 1-7 in which there is a screen with a mesh size of 0.006-0.012 inches.

9. The process of any one of Claims 1-8 in which the coated paperboard is coated on both sides of the layer of cellulosic fibres.

10. The process of any one of Claims 1-9 in which the solution of (a) contains potassium hydroxide and/or sodium hydroxide.

11. The process of any one of Claims 1-10 in which the foil is aluminum foil.

12. The process of any one of Claims 1-11 in which the process includes a step of de-inking the cellulosic fibres in the aqueous solution.

13. The process of any one of Claims 4-12 in which the cellulosic fibres are combined with the aqueous solution from the pulper.

14. The process of any one of Claims 1-12 in which, in step (b), separation is effected using a bucket conveyer.

15. The process of Claim 14 in which the bucket conveyer comprises a bucket with orifices or mesh in the bottom thereof.

16. The process of Claim 14 in which the bucket conveyer has at least two tynes to effect such separation.

17. A process for the separation of cellulosic fibres from coated paperboard, said coated paperboard being comprised of at least one layer of cellulosic fibres coated on at least one side with at least one of thermoplastic polymer and metallic foil, comprising:

(a) pulping the coated paperboard in aqueous solution in a pulper vessel, at substantially neutral or alkaline pH, said pulper vessel having rotating knives located in the bottom thereof effective for pulping of said paperboard to form a suspension of cellulosic fibres in the aqueous solution;

(b) continuously passing solution from the vessel of (a) to a coarse screen having a mesh size to effect separation of a substantial portion of the thermoplastic polymer and foil from cellulosic fibres, solution with cellulosic fibres passing through the screen;

(c) subjecting the solution passing through the screen to at least two hydrocyclone cleaners, the first of said hydrocyclone cleaners being adapted for rejection of material lighter than cellulosic fibres and the second of the hydrocyclone cleaner being adapted for the rejection of material heavier than cellulosic fibres; and

(d) separating cellulosic fibres from the solution of (c).

18. The process of Claim 17 in which the aqueous solution has a pH that is substantially neutral to alkaline.

19. The process of any one of Claims 1-17 in which the pH is substantially neutral.

20. The process of any one of Claims 1-17 in which the aqueous solution has a pH that is alkaline.

21. The process of any one of Claims 17-20 in which a bucket conveyer is used to remove thermoplastic polymer and/or metallic foil from the pulper vessel.

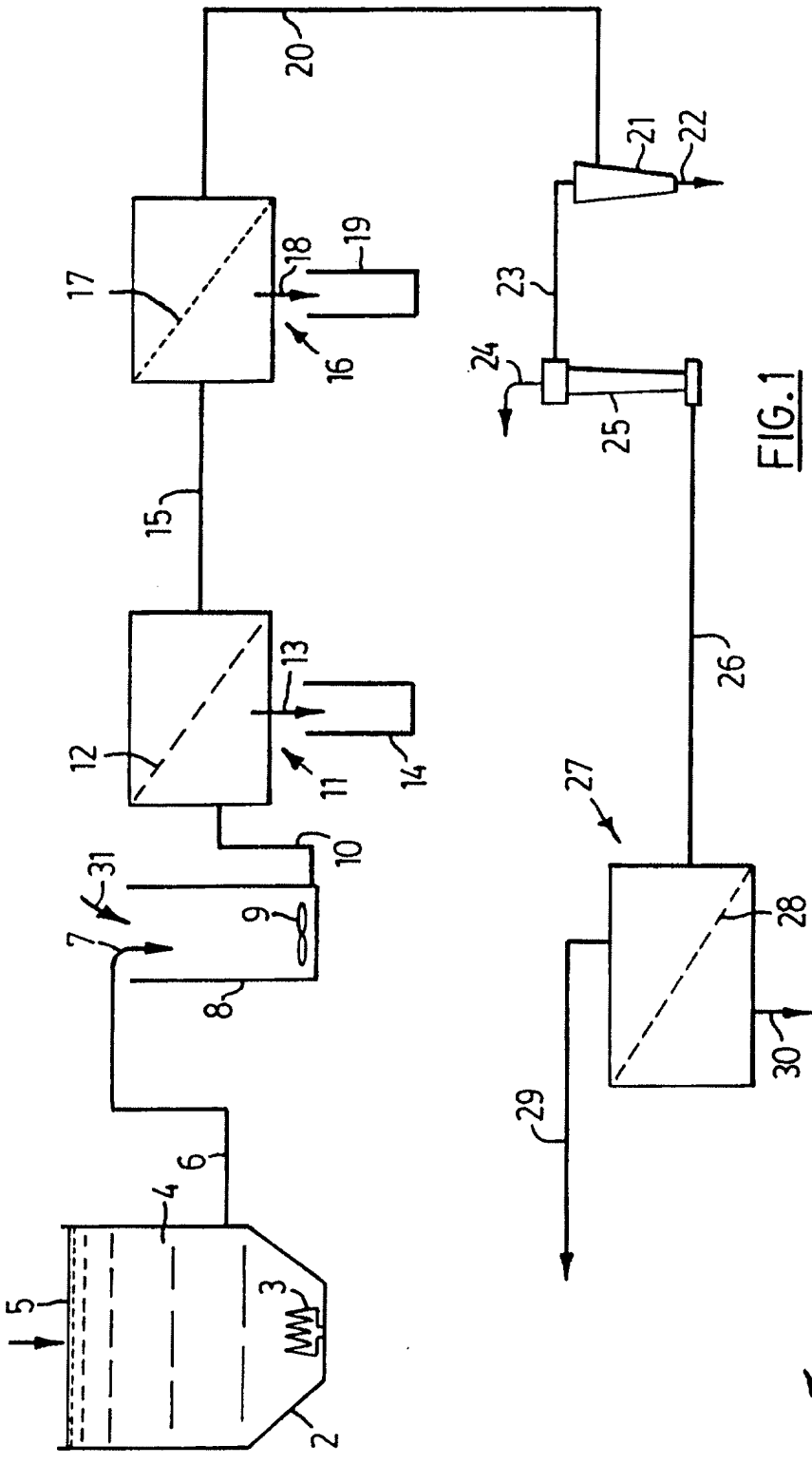
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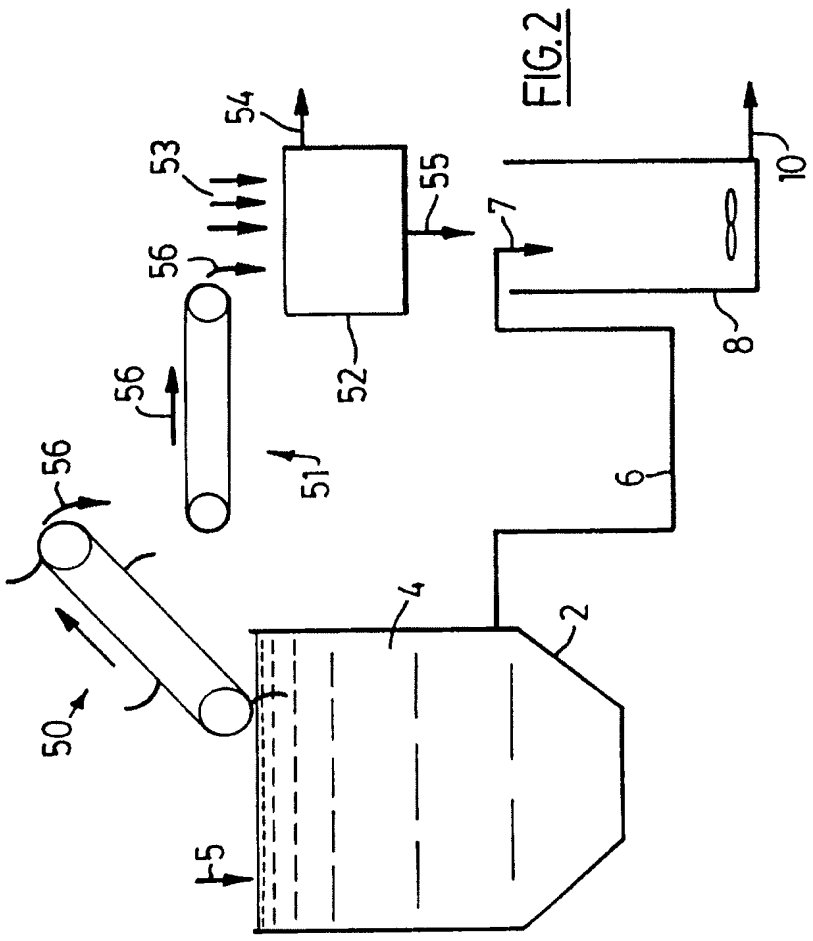
FIG. 1

FIG.2



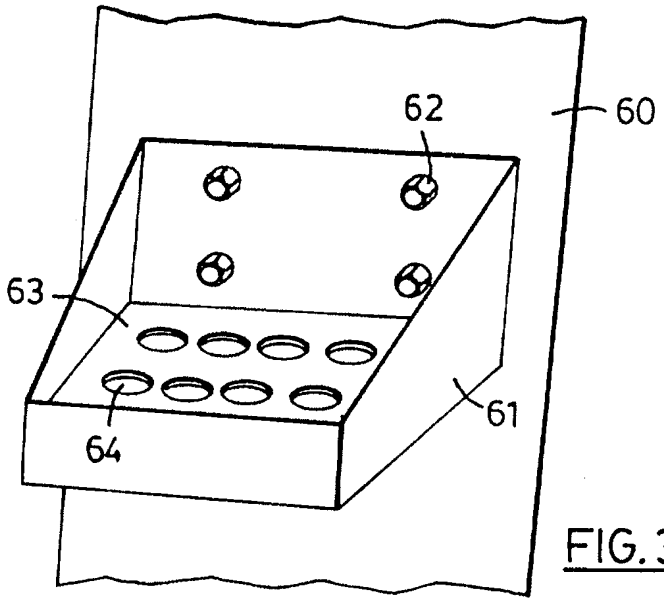


FIG. 3A

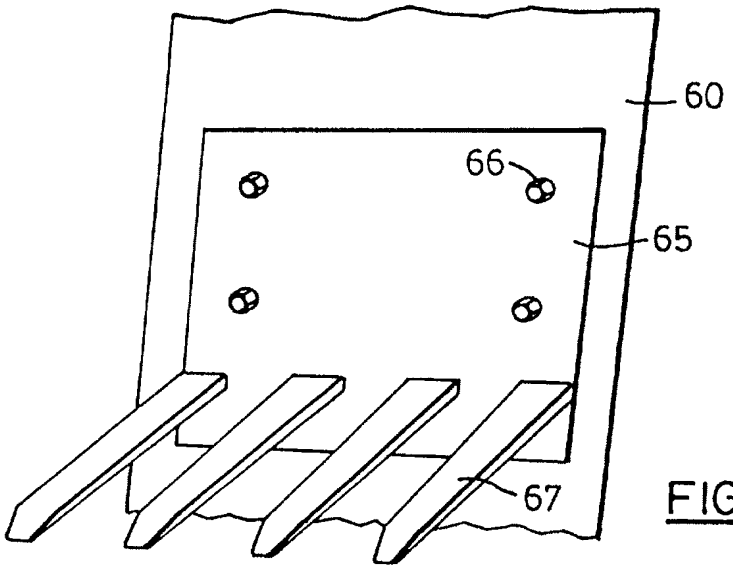


FIG. 3B

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 95/00702

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21B1/32 D21B1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21B D21D D21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 570 757 (TETRA ALFA HOLDINGS S.A.) 24 November 1993 see claims 1-4,9,12; figure 1 see page 4, line 3 - line 19 see page 14, line 33 - page 16, line 2 see column 1, line 3 - line 12 see column 3, line 4 - line 38 see column 5, line 51 - line 55 see column 6, line 41 - column 9, line 32	17,18,20
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
1 April 1996	26.04.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Häusler, F.U.

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International Application No
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